Interaction of nano zero valent iron and natural organic matter: sorption of humic acid and effect on TCE degradation

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Nano zero valent iron (nano-Fe^0) has been attractive to use in groundwater remediation, such as in situ degradation of trichloroethylene (TCE). Natural organic matter (NOM) is ubiquitous in the environment. Therefore, the interaction of nano-Fe^0 and NOM should be addressed for the sorption/desorption of NOM and the effect on the removal of TCE in groundwater.

In our present study, we synthesized nano-Fe^0 and bentonite supported nanoscale Fe/Ni bimetals (bentonite-Fe/Ni). Humic acid (HA) was used as a representative model of NOM. Our research showed: (1) nano-Fe^0 could adsorb HA, and the sorption/desorption behavior could be influenced significantly by the pH value and the ionic compositions of the solution. It shows that when the pH value of solution was increased from 3 to 12, the adsorbtion of HA was decreased. And in alkaline condition, the surface charge of nano-Fe^0 caused the electrostatic repulsive forces between HA and the nano-Fe^0 particles, which promoted HA desorption greatly. As for anions and cations in solution, divalent cations (Ca^{2+}, Mg^{2+}) could enhanced HA adsorption significantly; however with the addition of phosphate, the HA desorption promoted greatly. (2) The degradation of TCE by nano-Fe^0 could decreased in the presence of HA, while HA enhanced significantly the degradation rate of TCE by bentonite-Fe/Ni. This peculiar phenomenon was elucidated for the presence of humic acid, serving as electron shuttles with the role of quinone moieties in bentonite-Fe/Ni system. A comparable experiment of a substitution of humic acid analogue quinone compound, named 9,10-anthraquinone-2, 6-disulfonate (AQDS), was showed the similar mechanism of enhanced degradation of TCE by bentonite-Fe/Ni.

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